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XXXII. *Observations on the Gillaroe Trout, commonly called in Ireland the Gizzard Trout, by John Hunter, F. R. S.*

Redde, March 17, 1774. **O**NE of the digestive organs of this trout being so very remarkable as to have given name to the fish, and to be looked upon as its distinguishing characteristic; it will be necessary, to take a general view of the varieties in the digestive organs of animals, to determine what place the stomach of this particular trout holds among them, and also to throw some light upon the question, whether its resemblance to a gizzard be such, as to render the name of *gizzard trout* a proper appellation.

To begin with some general facts: the food of animals may be divided into two kinds, such as does, and such as does not, require mastication, to facilitate the digestion. All animal food is of this latter kind. But grain, and many other substances which serve for aliment, require a previous grinding or trituration; and therefore those animals which live on such food, are furnished with organs for that purpose. Granivorous quadrupeds have the two powers, viz. mastication and digestion, separate or distinct from one another; the first being exerted by a set of teeth of a particular form,

form, which serve as so many grindstones for reducing their food to a powder, before it be conveyed into the stomach for digestion; and when so prepared, it is, with regard to the digestive power, become similar to animal food: therefore in many such animals the stomach is similar to that of the carnivorous; and whenever the stomach in granivorous quadrupeds differs from this general rule, there is a singularity in the operations of digestion. Such birds as live upon this kind of food, for the digestion of which trituration is indispensably necessary, have the powers of mastication and digestion united in one part; which is of a peculiar structure for that purpose; this is the *gizzard*. In granivorous birds therefore one single organ answers both to the teeth and stomach of granivorous quadrupeds, and consequently the gizzard alone of birds will point out the food of the species as clearly, as the teeth and stomach together do in other animals, in which the two offices of mastication and digestion are not joined together in the same part.

As it appears then to be the difference of the stomachs only, that fits birds for their different kinds of food, it is evident that every gradation of stomach must be found among them, from the true *gizzard* which is one extreme, to the more *membranous stomach* which is the other; since the food of different species is of every different kind, from the hardest grain, to the softest animal matter. In consequence of this, it must be as difficult to determine the exact limits of the two different constructions, to which the names of *gizzard* and *stomach* speci-

specifically belong, as, in any other case, to distinguish proximate steps in the slow and imperceptible gradations of nature.

The two extremes of true gizzard, and membranous stomach, are easily defined; but they run so into each other, that the end of one and the beginning of the other are quite imperceptible. Similar gradations are observed in the food; the kinds suited to the two extremes mixing together in different proportions, adapted to the intermediate states of stomach.

A true *gizzard* is composed of two strong muscles placed opposite, and acting upon each other, as two broad grindstones. These muscles are joined together at their sides by a middle tendon, into which the muscular fibres are inserted, and which forms the narrow anterior and posterior sides of the flat quadrangular cavity, in which the grinding is performed. The upper end of this cavity is filled up by the termination of the *œsophagus*, and the beginning of the intestine. The lower end consists of a thin muscular bag connecting the edges of the two muscles together.

By a soft flexible substance being thus interposed between the two strong grinding muscles, a double advantage is gained; for whilst it gives an easy passage to the *œsophagus* and gut above, it allows of that free motion of the grinding surfaces on each other, which is necessary for the comminution of the food. The half-muscular half-membranous bag, which is fitted on to the lower end of the cavity, at the same time that it serves for a reservoir, is perhaps the only part which has the
power

power of digestion, and therefore that is to be called the true *stomach*. In this case then we have some distinction between the two grand offices of mastication and digestion.

The two flat lateral sides of the grinding cavity are lined with a thick horney substance similar to a hard and thick cuticle: the narrow anterior and posterior tendinous parts are also lined with a cuticle, but not so strong as the former: this horney substance is gradually lost at one end in a very thin cuticle, which lines the passages of the *oesophagus* and intestine for a little way; and at the other end is also similarly lost in the membranous bag, or true stomach.

The two large muscles may be considered as a pair of jaws, whose teeth are taken in occasionally, being small rough stones or pebbles which the animal swallows: and from the feeling on the tongue, it can distinguish such of these as are proper, from those which are smooth or otherways unfit for the purpose, which last it instantly drops out of its mouth.

Some birds, with gizzards, have a *craw* or *crop* also, which serves as a reservoir, and for softening the grain; but as all of them have not this organ, it is not to our present purpose.

There are other animals besides that class of birds, which masticate their food in their stomach, but their teeth are placed there by nature: CRABS and LOBSTERS are of this kind

The gradation from *gizzard* to *stomach* is made by the muscular sides becoming weaker and weaker, and the true stomachic or gastric part proportiona-

bly larger and larger, in the successive order of birds, till at length it constitutes the whole of the organ; and the food keeps pace with this change, varying gradually from vegetable to animal. In one point of view, therefore, food may be considered as a first principle, with respect to which the digestive powers, with their appendages, are as secondary parts, being adapted to and determined by the food, as the primary object.

We find then that in granivorous animals of all sorts, there is an apparatus for the mastication of the food, although of different kinds and differently placed. But in true carnivorous animals of whatever tribe, mastication is not necessary, and therefore they have no apparatus for that purpose. The teeth of such quadrupeds, as are carnivorous, serve chiefly to procure food and prepare it for deglutition. The same thing holds in the true carnivorous bird, the office of whose beak and talons is to procure the aliment, and fit it for deglutition, corresponding in this respect to the teeth of the others. Applying this to fish, it seems, at first sight, that there is no occasion in them for that variety of structure in the digestive organs, which is found in the beforementioned quadrupeds and birds; the food of fish being principally of one sort, namely, animal, which however with regard to the digestive powers, is to be distinguished into two kinds, viz. common soft fish and shell-fish. Such fish as live on the first kind, have like the carnivorous quadrupeds and birds, no apparatus for mastication; their teeth being intended merely for catching the food and fitting it to be
swallowed.

swallowed. But the shells of the second kind of food render some degree of masticating power necessary, and accordingly we find in certain fish a structure suited to this purpose.

Thus the mouth of the WOLF-FISH is almost paved with teeth, by means of which he can break any shells to pieces, and so effectually disengage the food for digestion, that though he lives upon such hard food, his stomach does not differ from that of other fish: the organs of mastication and digestion therefore in this animal exactly correspond to those of many granivorous quadrupeds.

Other fish, on the contrary, approach nearer to the structure of birds, in having their stomach furnished with some degree of masticating power; but it is very imperfect, compared with that of the gizzard of fowls, though perhaps the difference is such only as the difference of food will properly allow: for in fish who have this power, the food being still animal, and but imperfectly covered with the shell, it perhaps wants only to be broken; whereas that of granivorous birds requires to be ground into a kind of meal.

Of all the fish I have seen, the MULLET is the clearest instance of this structure; its strong muscular stomach being evidently adapted, like the gizzard of birds, to the two offices of mastication and digestion. The stomach of the fish now before us holds the second place.

But still neither of those stomachs can be justly ranked as *gizzards*, since they want some of the most essential characters, *viz.* a power and motion fitted for grinding, and the horny cuticle. The stomach

of the GILLAROO TROUT is however more circumscribed than that of most fish, better adapted for small food, and endued with sufficient strength to break the shells of small shell fish; which will most probably be best done by having more than one in the stomach at a time, and also by taking pretty large and smooth stones into the stomach, which will answer the purpose of breaking; but not so well that of grinding; nor will they hurt the stomach as they are smooth, when swallowed: but this stomach can scarcely possess any power of grinding, as the whole cavity is lined with a fine villous coat, the internal surface of which appears every where to be digestive, and by no means fitted for mastication.

The stomach of the ENGLISH TROUT is exactly of the same species with the GILLAROO, but its coat is not so thick by $\frac{2}{3}$ (a). How far this difference in thickness of stomach is sufficient to make a distinct species, or barely a variety of the same, is only to be determined by experiment (b).

The *oesophagus* in the trout is considerably longer and smaller than in many other classes of fish.

The intestines are similar to those of the salmon, herring, sprat, &c.

(a) The English trout swallows shell-fish, and also pretty large smooth stones, which serve as a kind of shell-breaker.

(b) *Viz.* Take some Gillaroo trout, male and female, and transplant them into some other water where there are no trout, so soon they continue the same.

The

The *pancreas* is appendiculated (c).

The teeth shew them to be fish of prey.

So far as we are led to determine by analogy, we must not consider the stomach of this fish as a *gizzard*, but as a true *stomach*.

(c) I chuse to give this name to the part from its appearance.